Comprehensive Water Master Plan - 2012

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Engineering Enterprises, Inc.

EXECUTIVE SUMMARY

The Village of Algonquin continues to be a vibrant and thriving community. The maturation of the community is visible in the amount of growth the Village has seen in the first decade of the 21st century and also in the progressive policies the Village Board has supported over that same time period. When the growth returns, it is clear the many positive attributes of the Village, including the Village's infrastructure, will provide a solid foundation for future growth potential. One component of the Village's infrastructure that is clearly an asset to the community is its Water Works System.

Regional population projections suggest Northeastern Illinois (11 county region of Cook, Lake, DuPage, Will, Kane, Kendall, McHenry, Dekalb, Boone, Kankakee and Grundy) may add as many as 4,000,000 new residents to the region by 2050. With this increase in growth, there will be additional demand on the region's water resources. Regional water planning by the Chicago Metropolitan Agency For Planning (CMAP) led Regional Water Supply Planning Group (RWSPG) have quantified the water supply and demand relationship throughout the region, and have concluded water conservation is necessary to provide for a sustainable region. Through its commitment for a sustainable community from not only an economic, but also an environmental perspective, the Village of Algonquin supports the recommendations of the RWSPG.

Even though the growth within the Village of Algonquin has stalled for a couple years, the regional growth projections suggest growth within the region will reemerge. That being said, periods of slowdown often provide excellent opportunities to plan for the future. With this lull in development, the Village Staff and Village Board wisely decided it was an ideal time to reevaluate the long term expansion of the Water Works System. Therefore, the Village embarked on completing this Comprehensive Water Master Plan. The main goal of this Comprehensive Water Master Plan is to provide planning to maintain a sustainable cost-efficient Water Works System for current and projected water uses. This Master Plan not only evaluates system expansion utilizing business as usual water use trends, referred to as Current Trends (CT) water use demands, but also evaluates the RWSPG's water conservation recommendations to define practical reductions in projected water demands. As one of the early leaders in the area, the Village of Algonquin first focused its water conservation efforts with the development of the Water Conservation Plan in 2003. It is clear that the community has responded to this plan and peak and average day water demands have decreased. However, this report will explore the potential of additional water conservation efforts and then calculate the capital cost savings these additional efforts can achieve. The future water demands that include water conservation strategies are defined as the Less Resource Intensive (LRI) water use projections. The Master Plan also evaluates system expansion utilizing the LRI projections, and finally identifies the capital cost savings the Village would realize with a further commitment to water conservation.

The Comprehensive Water Master Plan is divided into six (6) sections. A summary of each of the sections follows.

Introduction

The current Village corporate limits encompass about 12.39 square miles while the planning area outside of the corporate boundary adds another 3.35 square miles for a total of 15.74 square miles within the study area. The Village offers many opportunities for growth with a significant amount of undeveloped land mostly in the western portions of the study area and infill within the existing Village limits. These areas will one day provide homes to new Village residents, as well as, contribute to the local economy with new commercial, industrial and institutional land uses. Based on a Special Census completed in 2007, the Village's population was 30,482. The 2010 Census indicated the Village's population declined slightly to 30,046. The Village has established the year 2040 for the limits of this planning report. CMAP estimates the Village of Algonquin population at 51,656 people by 2040. This projection is consistent with the historical long term growth patterns in the Village and the amount of open space available for development.

Existing Water Works System

The Village of Algonquin began installing a public water supply in 1895. In the early years of the municipal Water Works System, the Village relied on mineral springs, an infiltration tile system, cisterns and a pump house to supply, store and distribute potable water to local residents. As Algonquin developed, the surface recharge to the springs was impacted and the amount of water available began to decline. Driven by regulations and relying on technological advances, the Village constructed Wells No. 5, 6, 7 and 11 in the localized shallow sand and gravel aquifer that was resourceful for the infiltration tile system for many years. The Village also built WTP No. 1 to treat the water from the wells. These improvements were all located east of the Fox River in the populated region of the Village at that time. With the westward growth, the Village completed shallow Wells No. 8 and 9 and deep Well No. 10 and constructed WTP No. 2 west of the Fox River. As the growth continued through mid-decade 2000, shallow Wells No. 13 and 15 along with WTP No. 3 were constructed on the far west developed region of the Village to provide the necessary potable water infrastructure that the growth commanded.

All of the shallow sand and gravel aquifer wells have measured iron concentrations that exceed the primary or secondary MCL and shallow Well No. 15 exceeds the secondary MCL for manganese. The remaining shallow wells, with the exception of Well No. 7, have an elevated amount of manganese that approaches the secondary MCL. All of the shallow wells have moderately high hardness with Wells No. 13 and 15 in the western service area having the highest reported hardness levels. Some of the shallow wells have elevated total dissolved solids with Wells No. 11 and 15 exceeding the secondary MCL. All of the wells, with the exception of Well No. 15, have background ammonia concentrations that appear to be somewhat elevated. As one might expect, deep Well No. 10 has measured concentrations of combined radium greater than the regulatory limit. Well No. 10 also has measured barium concentrations greater than the regulatory limit. The treatment systems used at WTP's No. 1, 2 and 3 are effective at removing ammonia, iron and manganese from the shallow wells and hardness, radium and barium from deep Well No. 10.

WTP's No. 1 and 2 use air stripping and media filtration with horizontal pressure vessels to remove hydrogen sulfide, iron and manganese impurities from the connected shallow raw water wells. WTP No. 2 also uses cation exchange to remove barium, radium and hardness from deep Well No. 10. WTP No. 3 uses air stripping and a low pressure immersed membrane system to remove hydrogen sulfide, iron and manganese impurities from the connected shallow raw water wells. An inventory and audit of each of the WTP's identified some potential deficiencies relating to preventative maintenance and operational control that should be addressed and therefore, will be included in the recommended improvements.

As of 2012, the Village operates and maintains eight shallow sand and gravel wells and one deep well that pump groundwater to three water treatment plants that distribute water to over 160 miles of water main and a combined 3.33 million gallons of elevated and ground water storage within six pressure zones. Seven booster pump stations assist with the transfer of water from a lower pressure zone to an adjacent higher pressure zone. The system provides potable water to approximately 30,000 people within the Village along with a host of other types of government/institution, commercial, and industrial consumers.

Water Use

The Village's water use from 2006 – 2010 was reviewed to identify recent water use trends for the Water Works System. The water supply and storage systems were assessed for adequacy using evaluation parameters that rate the strength of the supply and storage components. The evaluation concluded that the water supply test parameters were adequate and fairly stable over the period analyzed. However, *Peak Hour Storage* (the ability of the system to have sufficient storage to meet the peak hour demand for 4 hours without depleting storage more than 50 percent) fluctuated over the period and failed in years 2006, 2007 and 2009. These three years correlate with the highest annual maximum daily demand and the maximum day demand to average day demand (MDD:ADD) ratio throughout the period evaluated.

The system was evaluated for total projected CT and LRI water use with incremental P.E. increases to the year 2040 population projection of 51,656 (+21,610 P.E.). For the CT water use analysis, a water use per capita per day of 95 gallons, consistent with historical averages, was used to project the demand to 2040. The CT MDD and Maximum Hour Demand (MHD) for the planning period were established utilizing the historical MDD:ADD ratio of 1.75 and MHD:MDD ratio of 2.0. The evaluation concluded that *Peak Hour Storage* continues to fail with additional P.E. increases with an ultimate water storage capacity deficit of just over 2.5 million gallons by the end of the planning period. However, at P.E. increases over 5,000 P.E., *Reliable Source Capacity* (the ability of the system to supply the maximum day demand with all wells operating 12 hours per day) begins to fail, as well with an estimated water supply capacity deficit of 3,413 GPM by the end of the planning period.

The Village of Algonquin is interested in understanding the potential reduction in future water use and corresponding capital improvements resulting from a LRI demand scenario. To define a reasonable LRI demand scenario, a systematic process was used to efficiently review available information, select relevant water conservation strategies, and calculate estimated savings. Following a review of the 13 water conservation measures recommended by the RWSPG and then a quantification of the amount of demand reduction applicable programs could reasonably provide for the Village of Algonquin, it was determined the projected water use per capita per day could be reduced by 15% to 81 gallons under the LRI demand projection.

Therefore, for the LRI projected water use analysis, a use per capita per day of 81 gallons per capita per day water use was used to project the demand to 2040. The LRI MDD and MHD for the planning period were established utilizing the historical MDD:ADD ratio of 1.75 and MHD:MDD ratio of 2.0. The evaluation concluded that while the *Reliable Source Capacity and Peak Hour Storage* continue to fail with additional P.E. increases, the water supply deficit is cut in half to 1,700 GPM under the LRI scenario and the water storage capacity deficit is reduced from 2.55 million gallons under the CT scenario to just over 1.7 million gallons under the LRI scenario by the end of the planning period.

Regulatory Review

A comprehensive review of the existing and future regulations was conducted to determine the current and future regulatory status of the Water Works System. The Village of Algonquin's Water Works System is meeting all existing and near future regulations, and current system operation would meet the future regulations currently being contemplated.

Sustainable Source Water Assessment

The four sources of water supply available to the Village were analyzed for their long term sustainability potential. Regional modeling has indicated that the projected water use under the Regional CT or More Resource Intensive (MRI) scenarios could cause concern with the long-term sustainability of the shallow sand and gravel aquifer in the Algonquin area. However, with the continued implementation of conservation efforts, the LRI scenario is much more promising and demonstrates a more sustainable use of shallow wells. On the other hand, Village studies have indicated that the unconsolidated aquifer in the area has highly variable aquifer characteristics and in some instances, limited recharge and aerial extent which must be factored into reasonable well sustainable yield estimates. With all of this considered, continued use of the shallow sand and gravel aquifer can be a consideration for a portion of the Village's long term water supply plan. However, additional sources should be implemented in order to diversify the water supply.

Regional modeling of the deep sandstone aquifer indicates its long term sustainability could be an issue in parts of Northeastern Illinois by 2050. However, the regional projections indicate water levels within the

Algonquin area likely will remain reasonable even under significantly higher water demand scenarios. While the long term sustainability of the deep aquifer could be a concern for the region, it can be concluded that the use of the deep aquifer as a supply source for the Village of Algonquin within this report's planning period is appropriate. The Village and region should continue to conserve water such that the capacity of this limited resource can be extended, but ultimately large amounts of population growth in the region likely will force many portions of the region to consider other source water options in the long term. Also, due to the localized elevated levels of Barium and Radium in the Ironton-Galesville aquifer in the Algonquin planning area, the Mt. Simon formation is preferred over the Ironton-Galesville formation.

The sustainability of the Fox River as a source of supply was reviewed. Regional modeling indicates that the Fox River base flows are projected to increase over the current day flows for the entire Fox River Valley from Algonquin to Yorkville for both the CT and LRI water use scenarios, thus making the Fox River a viable candidate for additional sustainable water supply. However, due to the Village's investment in the existing shallow and deep wells and their associated Water Treatment Plant's, the implementation of the Fox River is not cost-effective when compared to adding additional shallow and deep wells, at this time. However, beyond the timeframe of this planning document, there may be a need and an opportunity to integrate the Fox River as a supply source into the Water Works System.

A Lake Michigan water interconnection may potentially become available from the Northwest Suburban Municipal Joint Action Water Agency (NSMJAWA). However, the charter members own all of the allocation and obtaining an allowance from one or more members would likely be an obstacle. Also, the extent of the capital improvements necessary to extend the service to Algonquin make the Lake Michigan interconnection cost prohibitive for the Village of Algonquin at this time.

For the basis of this Comprehensive Master Water Plan and for the 2040 planning period, continued use of the shallow sand and gravel aquifer and deep aquifer will be sustainable for the Village's immediate and long term water supply plan.

Evaluation and Recommendations

In order to correct the *Reliable Source Capacity* and *Peak Hour Storage Capacity* deficit for the projected CT and LRI water use scenarios, sustainable sources of water supply that include a combination of shallow and deep aquifer wells and additional storage will need to be integrated into the Water Works System.

Also, cursory review of the system and discussions with Village staff identified some areas that present challenges for the effective transfer of water and necessary fire flow conditions. In the absence of water modeling, it can be concluded that at a minimum, the Village should add a large diameter water main along IL Route 62 to more effectively transfer water in Zone 1 and especially across the Fox River. The Village recently upsized the 8" water main along IL Route 62 at the Fox River to a 12" water main. This evaluation

considers adding on to the existing 12" main with a 16" water main that extends to Pressure Zone 4 on the west side and to Pressure Zone 2 on the east side of the river.

The area of Eastgate Court, currently in Pressure Zone 1, has some ground elevations that are on the higher end of those that can be effectively served by Pressure Zone 1 and therefore maintaining adequate water pressures is a challenge. The evaluation considered expanding Pressure Zone 2 by adding an 8" water main into this area. Since Pressure Zone 2 operates within a higher elevation range, the Eastgate Court area would be more effectively served by Pressure Zone 2.

The recommended improvements will allow for water transfer with minimal headloss, appropriate water storage volume, and the required water supply and treatment to continue to provide safe and adequate water to the Village of Algonquin given both CT and LRI demand scenarios. The recommendations are broken down into supply, treatment, storage and distribution. Under the CT demand scenario, the following improvements are recommended:

- *Supply:*
  - Well No. 6 (Shallow) pumping modifications to 450 gpm
  - New 1,000 gpm Well No. 12 (Mt. Simon)
  - New 450 gpm Well No. 14 (Shallow)
  - New 500 gpm Well No. 16 (Shallow)
  - New 1,000 gpm Well No. 17 (Mt. Simon)
  - Preventative Maintenance on each of 8 shallow wells
  - Preventative Maintenance on deep Well No. 10
- *Treatment:*
  - WTP No. 1
    - ✓ Aerator, Filter and Scrubber Media Replacement
    - ✓ Well No. 7/11 Aerator Replacement
    - ✓ HSP Motors and VFD Addition
    - ✓ Minor upgrades to treat Wells No. 6 and 14
  - WTP No. 2
    - ✓ Aerator, Filter, and Cation Exchange Media Replacement
    - ✓ HSP Motors and VFD Addition
    - ✓ Minor Upgrades to treat deep Well No. 17
  - WTP No. 3
    - ✓ Aerator Media Replacement
    - ✓ HSP VFD Addition
    - ✓ Minor upgrades to treat Well No. 16
    - ✓ Expansion to Accommodate Well No. 12 (Actual Expansion Improvements Undetermined Until Well is Drilled but for Basis of Recommendations, HMO Treatment is Recommended)

- *Storage:*
  - 0.75 MG Spheroid EWST in Pressure Zone 3
  - 2.0 MG Spheroid EWST in Pressure Zone 5
- *Distribution:*
  - 16" Water Main along IL Route 62
  - 8" Water Main to Eastgate Court

With the reduction in water demands for the LRI scenario, the planning period system needs decrease. The changes to the recommended improvements with a future water demand that is consistent with the LRI projections are as follows:

- *Supply:*
  - Well No. 6 (Shallow) pumping modifications to 450 gpm
  - New 1,000 gpm Well No. 12 (Mt. Simon)
  - New 450 gpm Well No. 14 (Shallow)
  - Preventative Maintenance on each of 8 shallow wells
  - Preventative Maintenance on deep Well No. 10
- *Treatment:*
  - WTP No. 1
    - ✓ Aerator, Filter and Scrubber Media Replacement
    - ✓ Well No. 7/11 Aerator Replacement
    - ✓ HSP Motors and VFD Addition
    - ✓ Minor upgrades to treat Wells No. 6 and 14
  - WTP No. 2
    - ✓ Aerator, Filter, and Cation Exchange Media Replacement
    - ✓ HSP Motors and VFD Addition
  - WTP No. 3
    - ✓ Aerator Media Replacement
    - ✓ HSP VFD Addition
    - ✓ Expansion to Accommodate Well No. 12 (Actual Expansion Improvements Undetermined Until Well is Drilled but for Basis of Recommendations, HMO Treatment is Recommended)
- *Storage:*
  - 0.75 MG Spheroid EWST in Pressure Zone 3
  - 1.0 MG Spheroid EWST in Pressure Zone 5
- *Distribution:*
  - 16" Water Main along IL Route 62
  - 8" Water Main to Eastgate Court

Exhibits summarizing the Water Works System Master Plan for both the CT and LRI scenarios were developed. Capital cost estimates were developed for each of the improvements, and Phasing and Implementation Plans for the two water demand scenarios were created for the planning period. The projected capital investment for the supply, treatment, storage and distribution improvements to meet the CT water demand scenario were calculated to be $9,903,000, $4,791,000, $5,667,000 and $3,328,000, respectively. The total projected capital investment to meet the CT demands would be $23,689,000. With reduction in the required improvements to meet the LRI demand scenario, the total cost of the improvements for the planning period reduces to $17,333,000, which is nearly a $6,360,000 reduction.

Although both population and approximate timeframes for improvements were provided as part of the Master Plan Phasing and Implementation Plans, it will be ultimately the water demands on the system that dictate when and what improvements will need to be constructed. As the Village continues to mature, expand, and practice water conservation strategies, the water demands will evolve. It is recommended the Village continuously monitor and evaluate its Water Works System as the Village develops. The staging of these water works improvements is dependent on the construction schedule and financing of the annexed and proposed developments. The Phasing and Implementation Plan must continually be reviewed and should be modified based on the rate of development and where the development is actually occurring.

The nearly $6,360,000 capital cost difference between the CT and LRI scenarios clearly demonstrates the financial benefits of a modest reduction in per capita water use through increased water conservation can be overwhelming. To that end, this Comprehensive Water Master Plan is a valuable planning tool and stepping stone for the Village's Water Works System. The next steps for the Village are to establish policies regarding their water conservation strategies and goals and to develop financing alternatives for the identified improvements. By evaluating water conservation opportunities, the Village will not only show how they continue to be good stewards of our limited resource of water, but the Village also has the potential to significantly reduce the required capital investment in the system. To be successful from a financial perspective, it also is recommended that the Village review the water rates to determine how revenue will be impacted by a significant decrease in water consumption resulting from water conservation measures. In addition, we recommend the Village develop a formal emergency action plan to minimize water consumption during critical and/extreme circumstances whether the plan includes voluntary or mandatory actions.

This Master Plan advocates similar goals to those of the regional water supply planning efforts. The water supply sources of the western portion of Northeastern Illinois, namely shallow and deep groundwater and the Fox River, know no political boundaries. Their geographic extent is such that their availabilities are dependent on everyone's wise use of the resource. Therefore, we also recommend the Village continue to build strong, collaborative relationships regionally for sustainable water use so the region and the Village of Algonquin can extend the capacity of the local water resources for an economically and environmentally sustainable region.